environmental commodities for which the integral over infinite time converges) and permanent stressors (persistent or non-renewable environmental commodities for which the asymptotical presence or absence is used as a measure). The stressors are those entities that exert the impacts on the environment: it is not the release of a certain chemical to a certain compartment which is problematic, but the fact that this results in the (temporary) presence of a certain chemical in a certain compartment, while the chemical may have been transformed into a different one, and the compartment in which it is found may have changed following a transport process.

The starting point for the attribution of impacts to stressors is the design of a standard list of impact categories. Although it is difficult to establish a definite list, the current ideas within life-cycle impact assessment are followed as a best state-of-the-art. The quantitative measures for indicating the contribution to these impact categories are critically reviewed, however. It appears that, while much of the inventory work resembles the results for established lca-work, the impact analysis deviates in many respects:

1. In the *first* place, it is the consequent inclusion of fate which make a difference.

2. In the *second* place, the average attribution rule proposed from the epistemological principles designed to answer the attribution problem, do not appear to be in line with the majority of present approaches to life-cycle impact assessment. Neither are they in line with the established methods for substance-flow analysis, partly because these established approaches have not been designed for answering the attribution problem.

A quite new attribution system of environmental impacts is therefore proposed. Unfortunately, this proposal requires information that lies beyond the knowledge that can be accessed, because the chosen epistemological principles are not sufficient to construct a complete procedure.

The last element of Part 3 is the normative interpretation of environmental impacts in terms of the environmental problem that is perceived by individuals or by society. Once more, the aggregation rule follows from the epistemological principles but needs information that might be difficult to obtain.

Part 4 gives answers to the two main questions of this thesis. The attribution problem is solved by summarizing the formal unified structure of a number of tools for environmental analysis and decision-support. The position problem is answered by a comparative analysis of the different tools.

The study ends with a number of further questions and some more philosophical reflections.

The specific question addressed in this study was the attribution problem, which was introduced as the question of which environmental problems are to be attributed to which economic activities.

It is shown that the question of attribution is only one of the questions that can be posed in connection with environmental analysis and decision-support, and that other questions, in particular with respect to planning and scenario analysis, require distinctive epistemological principles, thereby leading to different implementations of the same tools of life-cycle assessment, substance-flow analysis, etc.

Moreover, the chosen epistemology is indeed a chosen one, and certainly not the only one. We therefore end up with a rather confusing situation: the question of the environmental friendliness of a certain economic activity cannot be unambiguously answered, as there are many competing truths. All of these truths correspond to a certain interpretation of the question: *"Should the activity be seen in a life-cycle perspective, in a substance-flow perspective, or as an independent entity? Are we considering an additional activity, or an average existing one?"*

Despite these open questions, the study can be seen as developing a foundation for a number of tools for environmental analysis and decision-support, a foundation which leaves minimum scope for ambiguities, inconsistencies, and arbitrariness.

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Announcement of a New Report

The Centre of Environmental Science of Leiden University (CML) announces a recent publication in the field of LCA impact assessment of input-related categories: natural resources and land use. The report was commissioned by the Japan Environmental Management Association for Industry (JEMAI), and is written by REINOUT HEIJUNGS, JEROEN GUINÉE and GJALT HUPPES.
It contains a survey and analysis of existing and proposed methods, covering a substantial part of the developments

during the nineties. The three main areas of discussion are extraction of abiotic resources, extraction of biotic resources, and land use. It concludes with recommendations for use and further research.
The report may be ordered through the library of CML, telephone +31-71-5277485, fax +31-5275587, postal address P.O. Box 9518, 2300 RA Leiden, The Netherlands. Please indicate the report number: 138. Costs are Dfl 20, excluding mailing costs.